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REPORT-PFP: a consensus from the International Patellofemoral Research Network to improve REPORTing of quantitative PatelloFemoral Pain studies

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ABSTRACT

Background Patellofemoral pain is a common and often debilitating musculoskeletal condition. Clinical translation and evidence synthesis of patellofemoral pain research is compromised by heterogenous and often inadequately reported study details. This consensus statement and associated checklist provides standards for REPORTing of quantitative PatelloFemoral Pain (REPORT-PFP) research to enhance clinical translation and evidence synthesis, and support clinician engagement with research and data collection.

Method A three-stage Delphi process was initiated at the 2015 International Patellofemoral Research Network (iPFRN) retreat. An initial e-Delphi activity (n=24) generated topics and items, which were refined at the 2017 iPFRN retreat, and voted on prior to and following the 2019 iPFRN retreat (n=51 current and past retreat participants). Voting criteria included 'strongly recommended' (essential), 'recommended' (encouraged) and uncertain/unsure. An item was included in the checklist if ≥70% respondents voted 'recommended'. Items receiving ≥70% votes for 'strongly recommended' were labelled as such.

Results The REPORT-PFP checklist includes 31 items (11 strongly recommended, 20 recommended), covering (i) demographics (n=2,4); (ii) baseline symptoms and previous treatments (n=3,7); (iii) outcome measures (2,4); (iv) outcomes measure description (n=1,2); (v) clinical trial methodology (0,3) and (vi) reporting study results (n=3,0).

Conclusion The REPORT-PFP checklist is ready to be used by researchers and clinicians. Strong stakeholder engagement from clinical academics during development means consistent application by the international patellofemoral pain research community is likely. Checklist adherence will improve research accessibility for clinicians and enhance future evidence synthesis.

INTRODUCTION

Patellofemoral pain is a common musculoskeletal condition. It affects 23% of the general population¹ and accounts for approximately 17% of all knee pain presentations to general practice.^{2,3} People

with patellofemoral pain presenting to sport and exercise medicine clinicians are of varying ages and activity levels, and report anterior knee pain that is aggravated by activities loading the patellofemoral joint (ie, stairs, running, squatting, etc).⁴

Systematic reviews, clinical practice guidelines⁵ and international consensus statements^{6,7} have been formulated to guide clinical practice for clinicians in how to treat people with patellofemoral pain. Yet, the credibility of recommendations and 'how to' guidance provided in these documents is compromised by heterogenous and often inadequately reported study details in the original research informing them. Our involvement in 14 key systematic review and meta-analyses published in the past 5 years to 2020^{5,8–20} has highlighted that key patient characteristics (eg, symptom duration, physical activity, body mass index (BMI), quality of life) and details of outcome measures (eg, validity, how to administer) are infrequently reported. This impedes trustworthy meta-analyses and prevents clinicians from judging the relevance of research findings to their patient population. The description of treatments provided in clinical trials often lacks sufficient detail to allow for replication in confirmatory research or use in clinical practice.^{17,18} For example, a 2017 review of exercise-therapy reported that no clinical trial provided complete exercise programme details to allow replication.^{17,18} Frequently missing data such as group mean and variance for key outcomes in prospective,⁸ cross-sectional^{9–14} and intervention studies^{5,10,12,15–20} also compromises important meta-analysis needed to better understand patellofemoral pain and guide practice.

The Enhancing the QUALity and Transparency Of Health Research (EQUATOR) network²¹ curates a library of quality checklists to guide reporting of studies, that typically focuses on particular methodologies (Strengthening the Reporting of Observational Studies in Epidemiology (STROBE), Consolidated Standards of Reporting Trials (CONSORT), etc) and indicate



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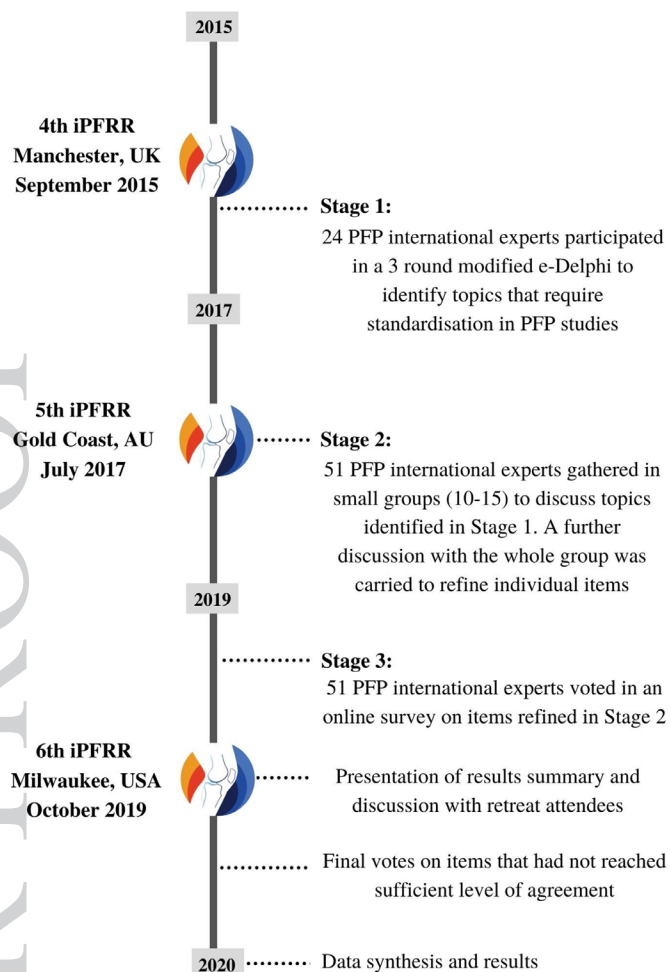


Figure 1 Timeline of the three stages and associated activities to produce the REPORTing of quantitative PatelloFemoral Pain (REPORT-PFP) checklist.

research credibility but do not consider or enhance clinical translation.²² Condition-specific reporting checklists^{23–25} can complement these generic methodological tools by focussing on the specific factors required for reporting to be optimally clinically relevant. The aim of this study was to provide a clearly defined, and widely accepted set of agreed-upon standards for REPORTing of quantitative PatelloFemoral Pain (REPORT-PFP) study. Our goal is to enhance research translation to clinical practice, facilitate more trustworthy evidence synthesis, and guide clinicians on how to contribute to research and data collection in their practice.

METHODS

Design

A three-stage modified Delphi process was initiated at the 2015 International Patellofemoral Research Network (iPFRN) retreat. Further work and discussions continued at the 2017 iPFRN retreat, and the consensus was completed following the 2019 iPFRN retreat (figure 1). The initial research design was undertaken by DM, CJB and SM using the principles outlined by Moher *et al.*²⁶

Stage 1

A modified e-Delphi technique²⁷ was facilitated via online questionnaires using password protected Google Forms (Mountain

View, California, USA). The initial content was informed from previous similar reports,^{23 28–30} and initial scoping discussions among a core group of authors (DM, CJB, SM, MC, MvM, KC, MR, BV). All 50 attendees from the 2015 Manchester iPFRN retreat were invited via email to participate as international experts following the conclusion of the retreat. The initial scoping survey was followed by a priority agreement survey, then a priority ranking survey (online supplemental file 1). Twenty-four attendees responded to the first survey (response rate=48%), 22 responded to the second and 19 to the third. Responding healthcare professions included physiotherapist/physical therapist (n=19), athletic trainer (n=1), sports medicine physician (n=2), human movement scientist (n=1) and other (n=1). Non-respondent participants in stage 1 were not excluded from participating in future rounds.

SM, CJB and DM analysed the findings after each survey round. Feedback from multiple participants during this initial stage 1 e-Delphi identified that further discussion about priorities and scope of this consensus were required to produce a more impactful document. Additionally, the recommended minimum number of 30 participants was not achieved for this e-Delphi process.^{31–34} Subsequently, analysis of information provided during stage 1 informed three distinct domains for further discussion and refinement at the 2017 iPFRN retreat, including (i) demographics; (ii) patient reported outcome measures and (iii) study and trial methodology.

Stage 2

At the 2017 Gold Coast iPFRN retreat (51 attendees, July 2017), small groups (approximately 10–15 participants) discussed the three distinct domains identified in stage 1. These groups met for 30 min to discuss and refine the draft set of recommendations developed during stage 1. Each meeting was led by a content expert, who subsequently presented the proposed recommendations to the whole group. A further period of discussion, facilitated by CJB, was then used to refine each list. Recordings of discussions undertaken during the retreat were reviewed by CJB and group discussion leaders (BV, MR, NC, MvM, KC) to ensure all suggested final changes to draft recommendations were adopted.

Stage 3

A further Delphi process was initiated prior to the most recent iPFRN retreat in Milwaukee (54 attendees, September 2019), starting with a survey to facilitate voting on final recommendations defined during stage 2 for demographics, patient reported outcome measures, and study trial and methodology. Review from a core group from the author panel (DM, CJB, MvM, KC, MR, BV, NC) grouped items to be voted into six sections, including (i) demographics; (ii) baseline symptoms and previous treatments; (iii) outcome measures; (iv) outcome measure description; (v) clinical trial methodology and (vi) reporting study results (online supplemental file 2). Following piloting, the survey was disseminated to all previous and 2019 iPFRN retreat participants (n=105). Final items to be voted on were succinct and clear statements. The survey also provided opportunity for feedback related to wording of each item as well as the option to suggest additional items for consideration. The core group could not define clear timeframes for short-term, medium-term and long-term follow-up. Therefore, an open-ended question was added to the survey to collate ideas from survey respondents.

The voting survey was disseminated via ‘Survey Monkey’ (San Mateo, USA). We sought to recruit at least 30 participants, recommended as the minimum required for stable results (ie, unlikely to change with inclusion of additional participants) based on similar Delphi studies.^{31–34}

The following voting criteria and wording was established for voting on each item:

- ▶ **Strongly recommend:** these items should be included and reported in all quantitative studies related to patellofemoral pain in order to meet consensus recommendations—that is, they are essential items.
- ▶ **Recommend:** encouraged to be considered and reported wherever relevant to the specific research question, but may not be considered applicable (ie, N/A) for some research studies—reporting N/A is therefore also possible for these items.
- ▶ **Uncertain/unsure (please explain why).**

We made an a priori decision to use a $\geq 70\%$ agreement criterion to reach consensus on an item to be strongly recommended or recommended, based on prior consensus derived recommendations.³³

The pre-retreat survey finding discussion was led by CJB during the 2019 iPFNR retreat, followed by group discussions and feedback. The group also discussed the additional items proposed in pre-retreat survey responses, followed by a post-retreat consensus voting survey for these items. Additionally, the group discussion led to some items that had not reached the $\geq 70\%$ agreement criterion initially, being included for post-retreat consensus voting. Following group discussion, it was decided this survey would only include two voting options for each item—‘recommend’ and ‘uncertain/unsure’, due to the later inclusion or re-voting for these items. This final post-retreat survey (online supplemental file 3) provided further opportunity for feedback on items included as strongly recommended and recommended from the pre-retreat survey voting. Completion of the post-retreat survey occurred during December 2019 and January 2020. A checklist of strongly recommended and recommended reporting items, and specific suggestions for how to apply the checklist and what to report informed by author group discussion, was developed following the retreat.²⁶

RESULTS

The consensus voting survey prior to the 2019 iPFNR retreat was completed by 51 current and past retreat participants (49% response rate) working in 10 countries (Australia=7; Brazil=7; Canada=3; Denmark=3; India=1; Italy=2; Kuwait=1; The Netherlands=2; UK=9; USA=16). The average completion time for the 58 questions was 25 min. There was substantial diversity in clinical experience treating patellofemoral pain patients (≤ 4 years=12 (24%); 5–10 years=9 (18%); 11–15 years=15 (29%); ≥ 15 (29%)), time treating patients per week (0–5 hours=32 (63%); 5–10 hours=10 (20%); 10–20 hours=3 (6%); >20 hours=6 (12%)) and time conducting research (0–5 hours=8 (16%); 5–10 hours=6 (12%); 10–20 hours=9 (18%); >20 hours=28 (56%)). Healthcare professional training of respondents included physiotherapy/physical therapy (n=26), athletic trainer (n=7) and medical (n=2).

The consensus voting outcomes prior to the 2019 iPFNR retreat are illustrated in figure 2 (22 items related to demographics, baseline symptoms and previous treatments), figure 3 (nine items related to outcome measures) and figure 4 (10 items related to trial methodology and study results). During this voting round, no consistent recommendations were provided in

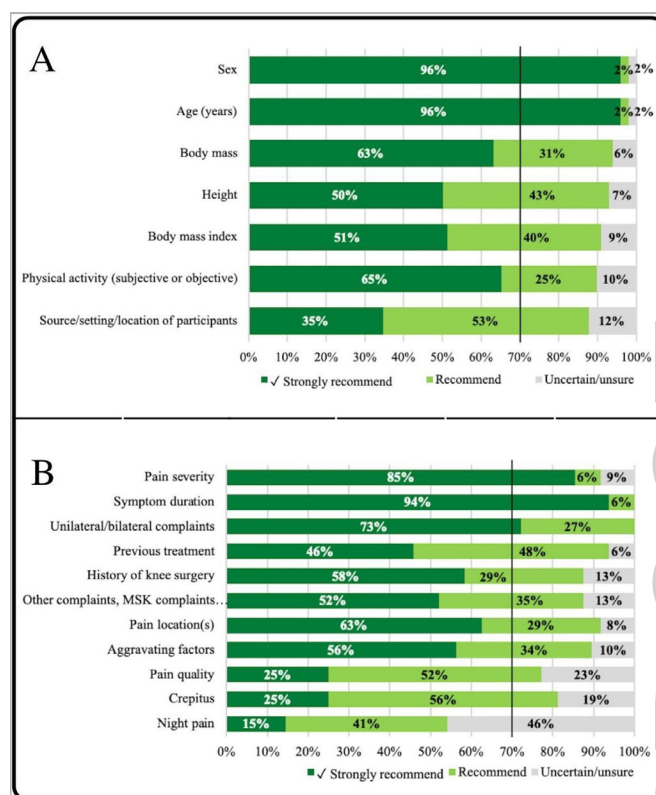


Figure 2 Consensus voting results for reporting demographics (A) and baseline symptoms and previous treatments (B). Vertical bar indicates 70% threshold for strongly recommended (dark green crosses line) or recommended (light green crosses line). MSK, musculoskeletal.

open ended responses to what should define short-term (ranged 2 weeks to 6 months), medium-term (ranged 2 weeks to 5 years) and long-term (ranged 4 weeks to >5 years).

The consensus voting survey after the 2019 iPFNR retreat was completed by 48 participants (46% response rate) working in nine countries (Australia=6; Brazil=6; Canada=2; Denmark=4; Italy=1; The Netherlands=3; Switzerland=1; UK=7; USA=18). Additional voting outcomes after the 2019 iPFNR retreat are illustrated in figure 5 (six items related to demographics and outcome measures). The final question ‘Do you have any final comments or suggestions?’ led to 11 responses. All indicated acceptance of the checklist, and no concerns or suggested changes to the items to be included as strongly recommended or recommended were raised.

Strongly recommended items

Eleven items voted on were strongly recommended for reporting ($\geq 70\%$ voted strongly recommended), including demographic items *age* and *sex* (figure 2A); baseline symptom items *pain severity*, *symptom duration* and *unilateral/bilateral symptoms* (figure 2B); outcome measure items *condition-specific patient-reported outcomes* and *pain severity* (figure 3A); outcome measure description item *describe assessment in adequate detail to allow replication* (figure 3B); and reporting study results items *reporting mean (SD)*, *median (IQR)* and *95% CIs for between group differences* (figure 4B). Suggestions on what to report for each strongly recommended (ie, essential) item provided by the author panel are provided in online supplemental file 4, and are freely available in online (www.ipfnr.org).

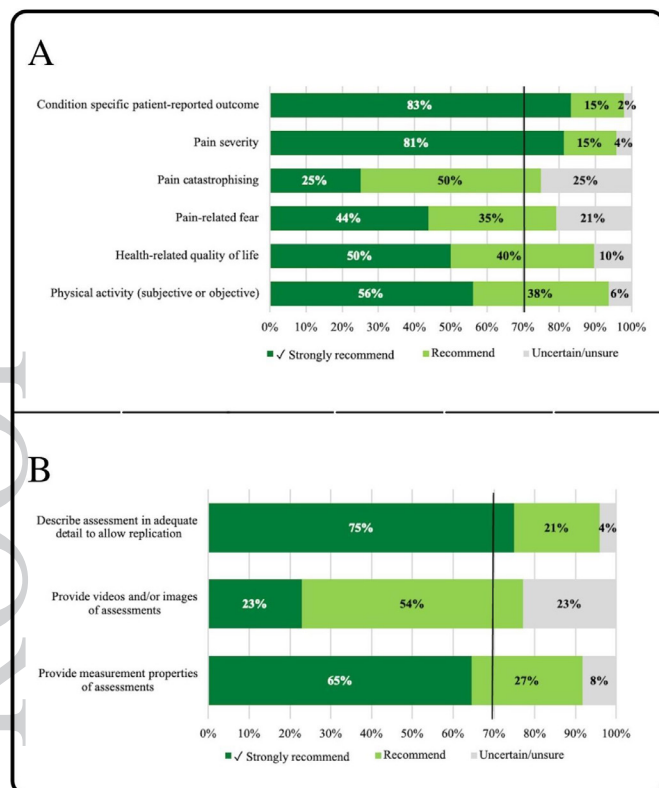


Figure 3 Consensus voting results for outcome measures (A) and outcome measure description (B). Vertical bar indicates 70% threshold for strongly recommended (dark green crosses line) or recommended (light green crosses line).

Recommended items

Twenty-eight items voted on were recommended ($\geq 70\%$ voted recommended or strongly recommended), including body mass, height, BMI, physical activity and source/setting/ location of participants (figure 2A); history of knee surgery, pain location, pain quality, crepitus, aggravating factors, other complaints/ musculoskeletal complaints/comorbidities (figure 2B) and ethnicity (figure 5); pain catastrophising, pain-related fear, health-related quality of life, physical activity (figure 3A), and global rating of change (GROC) and self-efficacy (figure 5); providing measurement properties of assessments and providing videos and/or images of assessments (figure 3B); following reporting guidelines from Complete Exercise Reporting Template (CERT), Template of Intervention Description and Replication (TIDiER), Toigo and Boutellier and EQUATOR, providing videos and/or images of treatments (figure 4A); and including 6, 13, 26 and 52 weeks as preferred follow-up timeframes (figure 4B). Suggestions on what to report for each recommended (ie, encouraged but not essential) item from the author panel are provided in online supplemental file 4, and are freely available in online (www.ipfrn.org).

Not recommended/unsure

Four items did not reach consensus thresholds for recommended, including baseline symptom item *night pain* (figure 2B); and demographic items *socioeconomic status*, *work status* and *geographical location* (figure 5).

Final checklist

All 11 strongly recommended (essential) items were included in the final checklist. The number of recommended (encouraged)

items was reduced from 28 to 20 in the final checklist, facilitated via mergers and omissions. Specifically, (i) the three anthropometric measures (height, body mass, BMI) were combined; (ii) the three psychological outcome measures (self-efficacy, pain-related fear, pain catastrophising) were combined; (iii) the three existing checklists for interventions (TIDiER, CERT, Toigo and Boutellier) were combined and (iv) two study results items were removed (aim for longer follow-up; use 6 weeks, 3, 6 and 12 months as follow-up time points). The final REPORT-PFP checklist is provided in table 1, and freely available in online (www.ipfrn.org).

DISCUSSION

The 31-item REPORT-PFP checklist will enhance clinical practice by improving research reporting and translation. It will also facilitate evidence synthesis, and guide clinicians on how they can contribute to research and data collection in their practice. We used thorough and engaging iterative methods to develop the checklist.²⁶ This included guidance from an international expert panel, face-to-face and online consultation with large numbers of international patellofemoral pain researchers and clinicians, and multiple consensus voting rounds. Multiple opportunities for feedback were provided, and suggestions were incorporated before finalising the checklist and guidance.²⁶ Our comprehensive approach resulted in most items being recommended through consensus voting. We encourage peer reviewers and editors to consider submission of the REPORT-PFP checklist with all quantitative patellofemoral pain studies, and emphasise

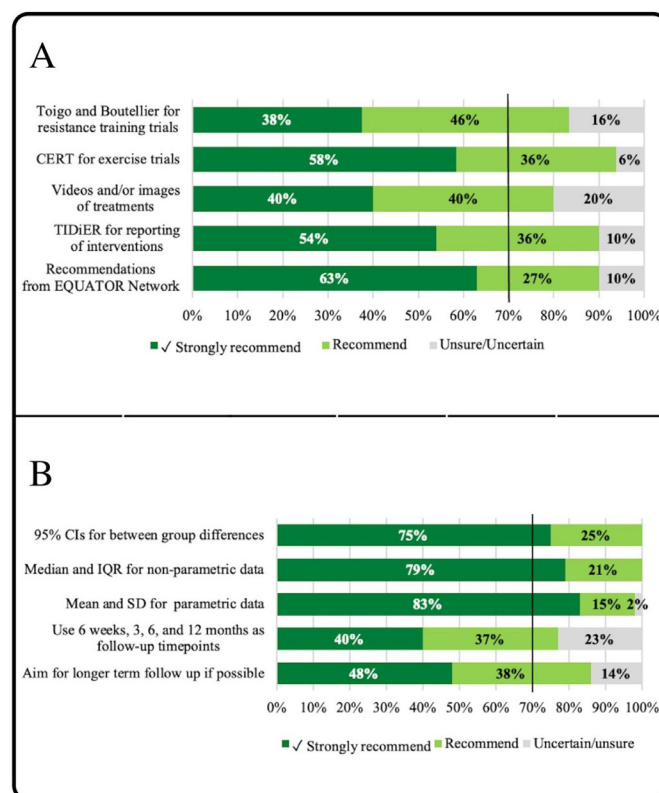


Figure 4 Consensus voting results for reporting trial methodology (A) and reporting study results (B). Vertical bar indicates 70% threshold for strongly recommended (dark green crosses line) or recommended (light green crosses line). CERT, Complete Exercise Reporting Template; EQUATOR, Enhancing the QUALity and Transparency OfHealth Research; TIDiER, Template of Intervention Description and Replication.

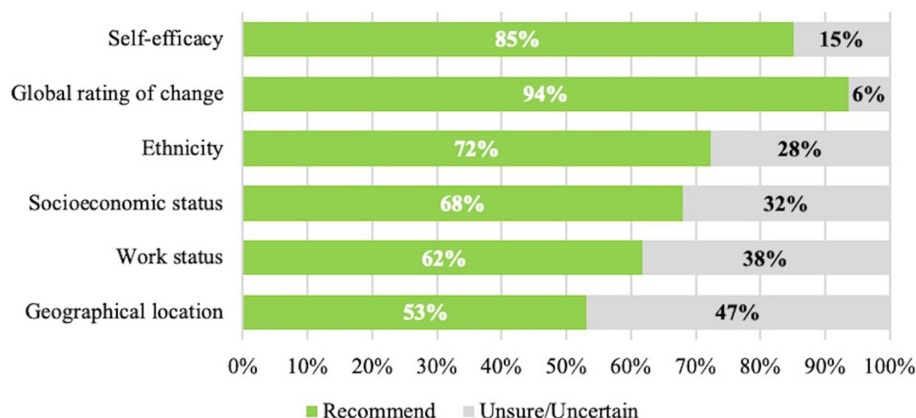


Figure 5 Consensus voting results for items discussed at the International Patellofemoral ResearchNetwork 2019 retreat and voted on after the retreat. Vertical bar indicates 70% threshold for recommended (light green crosses line).

adherence to the 11 ‘strongly recommended’ items. The full checklist and associated recommendations of what to report (online supplemental appendix 4) will be freely available on the iPFRN website (<https://ipfrn.org/report-pfp-checklist/>) to guide researchers and clinicians.

Strongly recommended items

Two demographic and three baseline symptom items are strongly recommended (table 1), with adherence needed to improve evidence synthesis, and for clinicians to understand the applicability of patellofemoral pain research findings to their patients. Participants’ sex is important, considering differences in muscle capacity and biomechanics between men and women with patellofemoral pain.^{35–39} Age is associated with greater muscle capacity impairments^{39 40} and development of patellofemoral osteoarthritis.^{41 42} Pain severity and symptom duration can impact prognosis in people with patellofemoral pain.¹⁴ Presence of unilateral or bilateral symptoms may reflect the magnitude of widespread pain and severity¹⁰ and/or reflect symmetrical mechanical features believed to relate to patellofemoral pain,⁴³ and could impact symptoms and prognosis.

Reporting pain severity and a condition-specific patient-reported outcome were strongly recommended, and will enable direct relationship of research findings to clinical presentations. We did not seek consensus on specific outcome measures, but further work with patients to address this will be carried out around the 2022 iPFRN retreat. In the interim, guidance notes provided in the REPORT-PFP checklist include suggestions of two condition-specific outcome measures—the Anterior Knee Pain Scale (AKPS)⁴⁴ and/or Knee injury and Osteoarthritis Outcome Score Patellofemoral subscale (KOOS-PF).⁴⁵ The AKPS⁴⁴ is the most widely used condition-specific outcome for patellofemoral pain, and is valid, responsive, and has excellent reliability in this population (intraclass correlation coefficient=0.81).⁴⁶ KOOS-PF,⁴⁵ published in 2018, was developed with input from 50 patients with patellofemoral pain and/or osteoarthritis and 14 healthcare professionals. Initial evaluation following the COSMIN checklist indicates adequate measurement properties, including internal consistency, test–retest reliability, validity and responsiveness.⁴⁵ Regardless of outcome measure choice, describing them in adequate detail to allow replication is strongly recommended, and will assist replication studies and ensure clinicians can confidently apply evidence-based assessments in their clinical practice, reducing research waste.⁴⁷

Reporting mean and SD for parametric data and median and IQR for non-parametric data, and 95% CIs for between-group differences is strongly recommended. These items were originally considered in the context of randomised controlled trial designs and between group differences. Following final consideration, we also recommend that precision of estimate should be provided for all inferential statistics, as is recommended in reporting guides for observational studies such as STROBE.⁴⁸ Adherence to these strong recommendations reflect EQUATOR Network tools,²¹ and will address historic barriers to data synthesis and meta-analysis experienced by patellofemoral pain researchers seeking to guide clinical practice.

Recommended items

Reporting the 20 ‘recommended’ items from the checklist will help clinicians interpret if the study’s findings are applicable to the patient in front of them. Adherence will also reduce challenges frequently faced by researchers completing evidence synthesis due to heterogenous and often inadequately reported study details. Additionally, recommended items can also be used to guide planning of future research related to patellofemoral pain, including potential contribution to data collection by practicing clinicians. Suggestions for implementation, including specific instruments, are provided in online supplemental file 4). Recommended demographic items including body mass, height and BMI have been inconsistently reported in past research,^{8 11} and physical activity⁴⁹ and ethnicity are seldomly reported. Yet each may plausibly influence prognosis and treatment outcomes,^{50–52} making them important considerations when interpreting research findings. Recommended baseline symptom items including knee crepitus, pain quality, pain location and aggravating factors, will help researchers and clinicians understand the important characteristics of the population being investigated. For example, crepitus is associated with fear of damage,⁵³ patellofemoral osteoarthritis on imaging⁵⁴ and risk of symptomatic knee osteoarthritis development,⁵⁵ all of which may influence prognosis and adherence to treatments such as exercise-therapy. Previous treatment, knee surgery history and other musculoskeletal complaints, and comorbidities may also influence prognosis,⁵⁶ making them important to know.

Inclusion of GROC,⁵⁷ psychological outcome measures (pain-related fear, pain catastrophising, self-efficacy), and health-related quality of life alongside self-reported pain and disability outcomes (eg, AKPS⁴⁴) may provide important insight into treatment outcomes and prognosis.^{9 13 58–61} Building on the strong

Table 1 Checklist of strongly recommended and recommended items for quantitative patellofemoral pain studies

Section 1—items strongly recommended (essential)		Reported on page # or N/A
<i>Demographic items</i>		
1	Sex or gender of the participants	
2	Age of the participants	
<i>Baseline symptoms and previous treatment items</i>		
3	Symptom duration	
4	Pain severity	
5	Unilateral/bilateral complaints	
<i>Outcome measure items</i>		
6	Condition-specific patient-reported outcome	
7	Pain severity	
<i>Outcome measure description</i>		
8	Describe assessment in adequate detail to allow replication	
<i>Reporting study results items</i>		
9	Mean and SD for parametric data	
10	Median and IQR for non-parametric data	
11	Precision of estimate for all inferential statistics (eg, 95% CI for between group differences)	
Section 2—items recommended (encouraged)		Reported on page # or N/A
<i>Demographic items</i>		
12	Anthropometrics (including body mass and height, or body mass index)	
13	Physical activity	
14	Source/setting/location of participants	
15	Ethnicity of the participants	
<i>Baseline symptoms and previous treatment items</i>		
16	Previous treatment	
17	Pain location(s)	
18	Aggravating factors	
19	History of knee surgery	
20	Other complaints, musculoskeletal complaints and comorbidities	
21	Crepitus	
22	Pain quality	
<i>Outcome measure items</i>		
23	Physical activity	
24	Global rating of change	
25	Health-related quality of life	
26	Psychological factors (including self-efficacy, pain-related fear and pain catastrophising)	
<i>Outcome measure description</i>		
27	Provide measurement properties of assessments	
28	Provide videos and/or images of assessments	
<i>Study methodology items, including reporting interventions</i>		
29	Follow recommendations from EQUATOR Network ²¹	
30	Use existing checklists for interventions, including TIDiER ⁶⁶ , CERT ^{67 68} for exercise interventions; and Toigo and Boutellier ^{17 69} for resistance training interventions	
31	Provide videos and/or images of treatments	

CERT, Complete Exercise Reporting Template; EQUATOR, Enhancing the QUALity and Transparency Of health Research; N/A, not applicable; TIDiER, Template of Intervention Description and Replication.

recommendation to describe outcome measures in adequate detail to allow replication, providing, or linking to, videos and/or images of any assessment or outcome measures is also recommended where possible. This can facilitate important ‘how to’

guidance for clinicians to implement new assessments into practice,⁶² and improve the ease of completing replication studies for other research groups.⁴⁷ Additionally, providing measurement properties including reliability and validity of those performing assessments will ensure the trustworthiness of data is clear to researchers and clinicians.⁶³ Our consensus process could not provide consistent definitions for short-term, medium-term and long-term timeframes. However, the consistent use of 6, 13, 26 and 52 weeks follow-up where possible for clinical trials was recommended through consensus voting.

Consensus voting supported EQUATOR Network²¹ recommendations for relevant study designs (eg, CONSORT,⁶⁴ STROBE⁶⁵), including the TIDiER checklist⁶⁶ to report interventions with the addition of CERT^{67 68} for exercise interventions. Adherence to these recommendations will help to address previous challenges with evidence synthesis and allow replication in future studies and clinical practice. For example, there is clear evidence that inadequate reporting of exercise-therapy programmes for patellofemoral pain has prevented recommendations about what type of exercise-therapy, if any, might be best.¹⁷ Beyond the EQUATOR Network,²¹ the REPORT-PFP provides important additional recommendations related to intervention reporting. Studies evaluating resistance training interventions are recommended to include detailed information based on the Toigo and Boutellier criteria,^{17 69} and provide videos and/or images of all interventions where possible to aid with replication in research and clinical practice.^{47 62}

Clinical implications

Systematic reviews, consensus statements and clinical practice guidelines are typically highly cited, meaning they are often considered of high quality by researchers and funders,⁷⁰ and are sought by quality journals. Yet, the heterogeneous and inadequate reporting of study details in patellofemoral pain research has meant the credibility of these evidence syntheses is frequently hampered. Additionally, no guideline has been able to provide clear guidance on ‘how to’ apply assessment and treatment recommendations for patellofemoral pain in clinical practice.⁷¹ Ultimately, this reduces the trust clinicians place in using research to inform care they provide, stifling the translation of evidence and guidelines to practice, as is evident in the management of patellofemoral pain.^{72 73} Our work to develop and disseminate the REPORT-PFP checklist was urgently needed to improve the trustworthiness of evidence syntheses, and help clinicians optimise evidence-based practice. If translatable research findings such as effective intervention are more readily applied by clinicians, this will improve research impact through improved health outcomes.⁷⁴ Our checklist and guidance notes (online supplemental appendix 4) will guide clinicians on how to embed data collection in their practice, and thus can facilitate development of a vital ‘real world’ evidence-base for one of the most commonly encountered musculoskeletal conditions.¹

Limitations

Although we conducted extensive face-to-face and online consultation with the international patellofemoral research community, 20 of our 31 items were categorised as ‘recommended’, rather than ‘strongly recommended’. Our consensus voting to develop the REPORT-PFP checklist did not include patient voices and further work is planned to address this. This will focus on refining items included (ie, how/what to specifically report—eg, which patient reported outcomes). We expect this work will lead to many ‘recommended’ items becoming ‘strongly recommended’

in the future. Health professional training of our experts in the final round of consensus voting (2019) was predominantly physiotherapy/physical therapy (52%), with limited representation of researchers with a medical training (8%). The consensus participants are representative of the main research and clinical community treating patellofemoral pain. However, seeking additional feedback and critique of this checklist from general practitioners, rheumatologists, sports physicians and surgeons, who also commonly manage and research people with patellofemoral pain, may help to optimise acceptance and adoption.

We have not provided specific guidance for reporting biomechanical and imaging research in people with patellofemoral pain, with further work planned to extend the checklist to cover these specific fields of research. A concurrent iPFNR consensus related to pain and psychological features in the field of patellofemoral pain was developed during the 2019 iPFNR retreat,⁷⁵ providing guidance to researchers working in these fields. Evaluating uptake and effectiveness of the REPORT-PFP checklist, and iterative refinement will be priorities for this group. User feedback will be facilitated via an embedded survey on the iPFNR website (<https://ipfnr.org/report-pfp-checklist/>), allowing researchers and clinicians to evaluate usability and applicability, and providing an opportunity for suggestions on refinement. We expect the REPORT-PFP checklist to evolve based on this feedback, emerging evidence, understanding related to patellofemoral pain, and patient input. Any updates will be provided via the iPFNR website.

CONCLUSION

Strong recommendations about what essential items should be reported, along with a larger list of recommended items that should be considered in future patellofemoral pain research are provided. Strong stakeholder engagement during development of the REPORT-PFP checklist means consistent application by the international patellofemoral pain research community is likely. Adherence to the checklist, which provides standards for REPORT-PFP should improve clinical translation, clarity and trustworthiness of evidence syntheses, and guide sports medicine clinicians on how to collect data in their own practice.

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REFERENCES

- Smith BE, Selfe J, Thacker D, et al. Incidence and prevalence of patellofemoral pain: a systematic review and meta-analysis. *PLoS One* 2018;13:e0190892.
- van Middelkoop M, van Linschoten R, Berger MY, et al. Knee complaints seen in general practice: active sport participants versus non-sport participants. *BMJ Musculoskelet Disord* 2008;9:36.
- Wood L, Muller S, Peat G. The epidemiology of patellofemoral disorders in adulthood: a review of routine general practice morbidity recording. *Prim Health Care Res Dev* 2011;12:157–64.
- Crossley KM, Callaghan MJ, van Linschoten R. Practice pointer Patellofemoral pain. *BMJ* 2015;351. doi:10.1136/bmj.h3939
- Willy RW, Hoglund LT, Barton CJ, et al. Patellofemoral pain. *J Orthop Sports Phys Ther* 2019;49:CPG1–95. doi:10.2519/jospt.2019.0302
- Collins NJ, Barton CJ, van Middelkoop M, et al. 2018 consensus statement on exercise therapy and physical interventions (orthoses, taping and manual therapy) to treat patellofemoral pain: recommendations from the 5th International Patellofemoral pain research retreat, gold Coast, Australia, 2017. *Br J Sports Med* 2018;52:1170–8. doi:10.1136/bjsports-2018-099397
- Crossley KM, van Middelkoop M, Callaghan MJ, et al. 2016 Patellofemoral pain consensus statement from the 4th International Patellofemoral pain research retreat,

- Manchester. Part 2: recommended physical interventions (exercise, taping, bracing, foot orthoses and combined interventions). *Br J Sports Med* 2016;50:844–52.
- 8 Neal BS, Lack SD, Lankhorst NE, et al. Risk factors for patellofemoral pain: a systematic review and meta-analysis. *Br J Sports Med* 2019;53:270–81.
 - 9 Coburn SL, Barton CJ, Filbay SR, et al. Quality of life in individuals with patellofemoral pain: a systematic review including meta-analysis. *Phys Ther Sport* 2018;33:96–108.
 - 10 De Oliveira Silva D, Rathleff MS, Petersen K, et al. Manifestations of pain sensitization across different painful knee disorders: a systematic review including meta-analysis and meta-regression. *Pain Med* 2019;20:335–58.
 - 11 Hart HF, Barton CJ, Khan KM, et al. Is body mass index associated with patellofemoral pain and patellofemoral osteoarthritis? A systematic review and meta-regression and analysis. *Br J Sports Med* 2017;51:781–90.
 - 12 Neal BS, Barton CJ, Gallie R, et al. Runners with patellofemoral pain have altered biomechanics which targeted interventions can modify: a systematic review and meta-analysis. *Gait Posture* 2016;45:69–82.
 - 13 MacLachlan LR, Collins NJ, Matthews MLG, et al. The psychological features of patellofemoral pain: a systematic review. *Br J Sports Med* 2017;51:732–42.
 - 14 Matthews M, Rathleff MS, Claus A, et al. Can we predict the outcome for people with patellofemoral pain? A systematic review on prognostic factors and treatment effect modifiers. *Br J Sports Med* 2017;51:1650–60.
 - 15 Winters M, Holden S, Lura CB, Byrne C, et al. Comparative effectiveness of treatments for patellofemoral pain: a living systematic review with network meta-analysis. *Br J Sports Med* 2020. doi:10.1136/bjsports-2020-102819. [Epub ahead of print: 26 Oct 2020].
 - 16 Macri EM, Hart HF, Thwaites D, et al. Medical interventions for patellofemoral pain and patellofemoral osteoarthritis: a systematic review. *J Clin Med*. In Press 2020;9. doi:10.3390/jcm9113397. [Epub ahead of print: 23 Oct 2020].
 - 17 Holden S, Rathleff MS, Jensen MB, et al. How can we implement exercise therapy for patellofemoral pain if we don't know what was prescribed? A systematic review. *Br J Sports Med* 2018;52:385.
 - 18 Lack S, Barton C, Sohan O, et al. Proximal muscle rehabilitation is effective for patellofemoral pain: a systematic review with meta-analysis. *Br J Sports Med* 2015;49:1365–76.
 - 19 van der Heijden RA, Lankhorst NE, van Linschoten R, et al. Exercise for treating patellofemoral pain syndrome. *Cochrane Database Syst Rev* 2015;1:CD010387.
 - 20 de Oliveira Silva D, Pazzinatto MF, Rathleff MS, et al. Patient education for Patellofemoral pain: a systematic review. *J Orthop Sports Phys Ther* 2020;50:388–96.
 - 21 EQUATOR network. Available: <https://www.equator-network.org/>
 - 22 Network E. Reporting checklists for medical researchers. Available: <https://www.goodreports.org/>
 - 23 Delahunt E, Thorborg K, Khan KM, et al. Minimum reporting standards for clinical research on groin pain in athletes. *Br J Sports Med* 2015;49:775–81.
 - 24 Froud R, Eldridge S, Kovacs F, et al. Reporting outcomes of back pain trials: a modified Delphi study. *Eur J Pain* 2011;15:1068–74.
 - 25 McAlindon TE, Driban JB, Henrotin Y, et al. OARS clinical trials recommendations: design, conduct, and reporting of clinical trials for knee osteoarthritis. *Osteoarthritis Cartilage* 2015;23:747–60.
 - 26 Moher D, Schulz KF, Simera I, et al. Guidance for developers of health research reporting guidelines. *PLoS Med* 2010;7:e1000217.
 - 27 Diamond IR, Grant RC, Feldman BM, et al. Defining consensus: a systematic review recommends methodologic criteria for reporting of Delphi studies. *J Clin Epidemiol* 2014;67:401–9.
 - 28 Gribble PA, Delahunt E, Bleakley C, et al. Selection criteria for patients with chronic ankle instability in controlled research: a position statement of the International ankle Consortium. *Br J Sports Med* 2014;48:1014–8.
 - 29 Gribble PA, Delahunt E, Bleakley C, et al. Selection criteria for patients with chronic ankle instability in controlled research: a position statement of the International ankle Consortium. *J Orthop Sports Phys Ther* 2013;43:585–91.
 - 30 Gribble PA, Delahunt E, Bleakley CM, et al. Selection criteria for patients with chronic ankle instability in controlled research: a position statement of the International ankle Consortium. *J Athl Train* 2014;49:121–7.
 - 31 Clayton MJ. Delphi: a technique to harness expert opinion for critical decision-making tasks in education. *Educ Psychol* 1997;17:373–86.
 - 32 de Villiers MR, de Villiers PJT, Kent AP. The Delphi technique in health sciences education research. *Med Teach* 2005;27:639–43.
 - 33 Fink A, Kosecoff J, Chassin M, et al. Consensus methods: characteristics and guidelines for use. *Am J Public Health* 1984;74:979–83.
 - 34 Murry JW, Hammons JO. Delphi: a versatile methodology for conducting qualitative research. *Rev High Ed* 1995;18:423–36.
 - 35 Neal BS, Barton CJ, Birn-Jeffery A, et al. Increased hip adduction during running is associated with patellofemoral pain and differs between males and females: a case-control study. *J Biomech* 2019;91:133–9.
 - 36 Willy RW, Manal KT, Witvrouw EE, et al. Are mechanics different between male and female runners with patellofemoral pain? *Med Sci Sports Exerc* 2012;44:2165–71.
 - 37 Nakagawa TH, Moriya ETU, Maciel CD, et al. Trunk, pelvis, hip, and knee kinematics, hip strength, and gluteal muscle activation during a single-leg squat in males and females with and without patellofemoral pain syndrome. *J Orthop Sports Phys Ther* 2012;42:491–501.
 - 38 Bolgla LA, Earl-Boehm J, Emery C, et al. Comparison of hip and knee strength in males with and without patellofemoral pain. *Phys Ther Sport* 2015;16:215–21.
 - 39 Rathleff MS, Rathleff CR, Crossley KM, et al. Is hip strength a risk factor for patellofemoral pain? A systematic review and meta-analysis. *Br J Sports Med* 2014;48:1088.
 - 40 Rathleff CR, Baird WN, Olesen JL, et al. Hip and knee strength is not affected in 12–16 year old adolescents with patellofemoral pain—a cross-sectional population-based study. *PLoS One* 2013;8:e79153.
 - 41 Crossley KM. Is patellofemoral osteoarthritis a common sequela of patellofemoral pain? *Br J Sports Med* 2014;48:409–10.
 - 42 Collins NJ, Oei EHG, de Kanter JL, et al. Prevalence of radiographic and magnetic resonance imaging features of Patellofemoral osteoarthritis in young and middle-aged adults with persistent Patellofemoral pain. *Arthritis Care Res* 2019;71:1068–73.
 - 43 Powers CM, Witvrouw E, Davis IS, et al. Evidence-based framework for a pathomechanical model of patellofemoral pain: 2017 patellofemoral pain consensus statement from the 4th International Patellofemoral pain research retreat, Manchester, UK: Part 3. *Br J Sports Med* 2017;51:1713–23.
 - 44 Kujala UM, Jaakkola LH, Koskenen SK, et al. Scoring of patellofemoral disorders. *Arthroscopy* 1993;9:159–63.
 - 45 Crossley KM, Macri EM, Cowan SM, et al. The patellofemoral pain and osteoarthritis subscale of the KOOS (KOOS-PF): development and validation using the COSMIN checklist. *Br J Sports Med* 2018;52:1130–6.
 - 46 Crossley KM, Bennell KL, Cowan SM, et al. Analysis of outcome measures for persons with patellofemoral pain: which are reliable and valid? *Arch Phys Med Rehabil* 2004;85:815–22.
 - 47 Ioannidis JPA, Greenland S, Hlatky MA, et al. Increasing value and reducing waste in research design, conduct, and analysis. *Lancet* 2014;383:166–75.
 - 48 Vandenbroucke JP, von Elm E, Altman DG, et al. Strengthening the reporting of observational studies in epidemiology (STROBE): explanation and elaboration. *PLoS Med* 2007;4:e297.
 - 49 Glaviano NR, Baellow A, Saliba S. Physical activity levels in individuals with and without patellofemoral pain. *Phys Ther Sport* 2017;27:12–16.
 - 50 Benatti FB, Pedersen BK. Exercise as an anti-inflammatory therapy for rheumatic diseases-myokine regulation. *Nat Rev Rheumatol* 2015;11:86–97.
 - 51 Booth FW, Laye MJ, Lees SJ, et al. Reduced physical activity and risk of chronic disease: the biology behind the consequences. *Eur J Appl Physiol* 2008;102:381–90.
 - 52 Orhan C, Van Looveren E, Cagnie B, et al. Are pain beliefs, Cognitions, and behaviors influenced by race, ethnicity, and culture in patients with chronic musculoskeletal pain: a systematic review. *Pain Physician* 2018;21:541–58.
 - 53 Smith BE, Moffatt F, Hendrick P, et al. The experience of living with patellofemoral pain-loss, confusion and fear-avoidance: a UK qualitative study. *BMJ Open* 2018;8:e018624.
 - 54 Schiphof D, van Middelkoop M, de Klerk BM, et al. Crepitus is a first indication of patellofemoral osteoarthritis (and not of tibiofemoral osteoarthritis). *Osteoarthritis Cartilage* 2014;22:631–8.
 - 55 Lo GH, Strayhorn MT, Driban JB, et al. Subjective Crepitus as a risk factor for incident symptomatic knee osteoarthritis: data from the osteoarthritis initiative. *Arthritis Care Res* 2018;70:53–60.
 - 56 Artus M, Campbell P, Mallen CD, et al. Generic prognostic factors for musculoskeletal pain in primary care: a systematic review. *BMJ Open* 2017;7:e012901.
 - 57 Kamper SJ, Maher CG, Mackay G. Global rating of change scales: a review of strengths and weaknesses and considerations for design. *J Man Manip Ther* 2009;17:163–70.
 - 58 Martinez-Calderon J, Zamora-Campos C, Navarro-Ledesma S, et al. The role of self-efficacy on the prognosis of chronic musculoskeletal pain: a systematic review. *J Pain* 2018;19:10–34.
 - 59 de Oliveira Silva D, Barton CJ, Briani RV, et al. Kinesiophobia, but not strength is associated with altered movement in women with patellofemoral pain. *Gait Posture* 2019;68:1–5.
 - 60 De Oliveira Silva D, Willy RW, Barton CJ, et al. Pain and disability in women with patellofemoral pain relate to kinesiophobia, but not to patellofemoral joint loading variables. *Scand J Med Sci Sports* 2020;30:2215–21.
 - 61 MacLachlan LR, Matthews M, Hodges PW, et al. The psychological features of patellofemoral pain: a cross-sectional study. *Scand J Pain* 2018;18:261–71.
 - 62 Barton CJ, Merolli MA. It is time to replace publish or perish with get visible or vanish: opportunities where digital and social media can reshape knowledge translation. *Br J Sports Med* 2019;53:594–8.
 - 63 Portney L, Watkins M. *Foundations of clinical research: applications to practice*. 2 edn. Upper Saddle River, NJ: Prentice-Hall, 2000.
 - 64 Moher D, Hopewell S, Schulz KF, et al. Consort 2010 explanation and elaboration: updated guidelines for reporting parallel group randomised trials. *J Clin Epidemiol* 2010;63:e1–37.
 - 65 Lowe A, Littlewood C, McLean S, et al. Physiotherapy and physical activity: a cross-sectional survey exploring physical activity promotion, knowledge of physical activity guidelines and the physical activity habits of UK physiotherapists. *BMJ Open Sport Exerc Med* 2017;3:e000290.

- 66 Hoffmann TC, Glasziou PP, Boutron I, et al. Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide. *BMJ* 2014;348:g1687.
- 67 Slade SC, Dionne CE, Underwood M, et al. Consensus on exercise reporting template (CERT): explanation and elaboration statement. *Br J Sports Med* 2016;50:1428–37.
- 68 Slade SC, Dionne CE, Underwood M, et al. Consensus on exercise reporting template (CERT): modified Delphi study. *Phys Ther* 2016;96:1514–24.
- 69 Toigo M, Boutellier U. New fundamental resistance exercise determinants of molecular and cellular muscle adaptations. *Eur J Appl Physiol* 2006;97:643–63.
- 70 Carpenter CR, Cone DC, Sarli CC. Using publication metrics to highlight academic productivity and research impact. *Acad Emerg Med* 2014;21:1160–72.
- 71 Wallis JA, Roddy L, Bottrell J, et al. A systematic review of clinical practice guidelines for physical therapist management of Patellofemoral pain. *Phys Ther* 2021;101. doi:10.1093/ptj/pzab021. [Epub ahead of print: 03 Mar 2021].
- 72 Smith BE, Hendrick P, Bateman M, et al. Current management strategies for patellofemoral pain: an online survey of 99 practising UK physiotherapists. *BMC Musculoskelet Disord* 2017;18:181.
- 73 Barton CJ, Ezzat AM, Bell EC, et al. Knowledge, confidence and learning needs of physiotherapists treating persistent knee pain in Australia and Canada: a mixed-methods study. *Physiother Theory Pract*. In Press 2021:1–13.
- 74 Rice DB, Raffoul H, Ioannidis JPA, et al. Academic criteria for promotion and tenure in biomedical sciences faculties: cross sectional analysis of international sample of universities. *BMJ* 2020;369:m2081.
- 75 Vicenzino B, Rathleff MS, Holden S. Clinical and research priorities on pain and psychological features in individuals who have patellofemoral pain: an international Delphi consensus study of patients and health care professionals. *Under review* 2021.

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